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GPO PRICE \$ \_\_\_\_\_

CFSTI PRICE(S) \$ \_\_\_\_\_

Hard copy (HC) 1.00

Microfiche (MF) .50

ff 653 July 65

1727-FR2

SUPPLEMENT TO  
FINAL REPORT

STUDY PROGRAM TO DETERMINE  
THE ACCELERATION ENVIRONMENT CAPABILITY  
OF THE GG159C GAS-BEARING SPINMOTOR

Jet Propulsion Laboratory  
Contract No. 950604

10 August 1964

FACILITY FORM 802	<b>N65-28851</b>	
	(ACCESSION NUMBER)	(THRU)
	<u>6</u>	<u>1</u>
	(PAGES)	(CODE)
	<u>CR 73844</u>	<u>16</u>
	(NASA CR OR TNX OR AD NUMBER)	(CATEGORY)

HONEYWELL

Aeronautical Division

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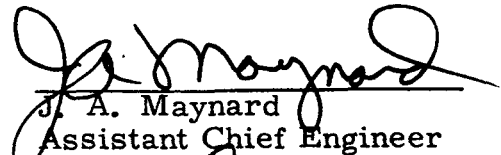
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This work was performed for the Jet Propulsion Laboratory,  
California Institute of Technology, sponsored by the  
National Aeronautics and Space Administration under  
Contract NAS7-100.

Honeywell Inc.  
Aeronautical Division  
Minneapolis, Minnesota

## GG159C GAS-BEARING LIFE TESTING AFTER EXPOSURE TO HIGH g ENVIRONMENTS

This report is a supplement to Honeywell Aero Report 1727-FR1 to document the life test of the motors placed on test at the time of writing 1727-FR1. The life testing of all motors has been included.

Two motors were subjected to g environments sufficient to cause bearing contact while operating and then placed on 500-hour life tests. Two motors were subjected to the JPL required g environments while nonoperating and then placed on life test.

### LIFE TEST CONCLUSIONS

The operating GG159C gas-bearing spinmotor is superior to the nonoperating motor in the ability to reliably operate after exposure to the JPL environments of 200 g 1.5-millisecond shock and 25 g rms (20-2000 cps) random vibration for the following reasons:

- The operating GG159C gas-bearing spinmotor will reliably operate after a few bearing contacts. This contact will take place at g levels greater than 200 g's shock with the improved motor developed in Phase II (1727-FR1, pages 9, 11, 22, and 36).
- The g environments of 25 g rms (20-2000 cps) random vibration and 200 g shock (1.5 millisecond) appear to be a hazard to the reliable operation of the nonoperating GG159C gas-bearing spinmotor.

## OPERATING MOTOR LIFE TEST RESULTS

### Motor J-2

This motor made bearing contact once each on the journal and thrust bearing. No particles could be found by recalibrating the motor. The motor lost synchronous speed only during bearing contact.

The life test on motor J-2 was conducted from 16 January to 11 February 1964 for a total of 647 hours. Results are summarized below:

- Phase current was essentially constant.
- Power was  $6.0 \pm 0.2$  watts.
- Ambient temperature was 140°F.
- The motor was not difficult to start at any time. No objectionable noise, which would indicate particles or very rough surfaces, could be heard when the motor was stopped.
- At the end of the life test, the motor started and stopped reliably without cleaning.
- Starting torques were initially less than 9000 dyne-cm and less than 11,000 dyne-cm after shock testing.

### Motor J-1

This motor made five bearing contacts during journal shock testing and eight during thrust shock testing. No particles could be found by recalibrating the motor. The motor lost synchronous speed temporarily during bearing contact and then resumed synchronous speed.

The life test on motor J-1 was conducted from 13 December 1963 to 10 January 1964 for a total of 497 hours. Results are summarized below:

- Phase current was essentially constant.
- Power was  $6.1 \pm 0.2$  watts.
- Ambient temperature was 140°F.
- The motor was difficult to start during the first few days. When the motor was stopped, no objectionable noise, which would indicate particles or very rough surfaces, could be heard through a sensitive microphone.
- At the end of the life test, the motor started and stopped reliably without cleaning.
- Starting torques were initially less than 11,000 dyne-cm. After the shock environment life test, the starting torques were irregular and less than 16,000 dyne-cm.

#### NONOPERATING MOTOR LIFE TEST RESULTS

A detailed discussion of the nonoperating performance under random vibration and shock is found in 1727-FR1, pages 13, 14, and 15.

#### Motor J-2 Life Test

The nonoperating random vibration motor J-2 was on life test for 166 hours when the magnetics (motor stator and rotor hysteresis ring) seized abruptly. The motor was started with difficulty at 118 and 142 hours. The seizure took place so quickly that the motor shaft was broken as the rotational energy was dissipated. It should be noted that other GG159C motors, not exposed to this

environment, have been on life test for over 10,000 hours without this kind of failure. Results are described below:

- Motor seizure at 166 hours
- Motor power - 6 watts prior to seizure
- Life test ambient temperature - 140°F

#### Motor J-3 Life Test

The nonoperating shock test motor (J-3) developed high load torques during its life test of 576 hours, from 23 June to 17 July 1964. A wear track was found upon motor inspection after the life test. Results are described below:

- Initial synchronous power was 6.2 watts
- Loss of synchronous speed after 24 hours of life testing, motor nonsynchronous power 7.5 watts
- Starting torques at motor build were less than 7000 dyne-cm
- Starting torques at end of life test were less than 23,000 dyne-cm on a thrust bearing and 9000 dyne-cm on the journal
- Life test ambient temperature was 140°F
- No particles could be found after the shock environment by recalibrating the motor
- A wear track was found on a thrust surface upon motor teardown examination after the life test